Technology Opportunity

Advanced Alloy Processing Improves Saw Blades

The Structures Division of the National Aeronautics and Space Administration (NASA) Lewis Research Center seeks to aid in the evaluation of materials and/or structures for advanced engineering applications. Areas of potential collaborative research include biomedical devices (prosthetics), structural integrity, design and manufacturing, composite materials, metals, plastics, and ceramics. Lewis can help with the multiaxial evaluation of monolithic structural materials and composite materials for nonaerospace applications, and with the characterization of high-temperature material behavior. Some of the benefits of collaborating with Lewis' Structures Division include low-cost material evaluations under prototypical operating conditions (i.e., high temperatures, multiaxial loads, environmental durability, etc.), reduced part rejection rates, improved structural durability, and improved material processing methods.

Potential Commercial Uses

Potential applications for nickel based alloys 908 and 909 with the Lewis heat treatment process include

- Thin lumber mill saw blades
- Sheathing for superconducting materials
- Heat shields
- Combustor liners
- Any other application that can benefit from a superalloy with low thermal expansion, high strength, and high ductility

Benefits

According to the Forest Products Laboratory (FPL) of the U.S. Department of Agriculture (USDA), these new saw blades when commercialized will recover approximately 5 percent of every log, which with the old blades would have become saw dust. If 500 out of the 800 total U.S. lumber mills were to use these blades to produce dimensional lumber, this 5-percent recovery would translate into 1 billion board feet of lumber annually, or over 200 million trees saved per year. Thanks to Lewis' efforts, the last hurdle has been overcome.

The Technology

For over ten years, FPL has been developing a thin "wobble-free" saw blade for the lumber industry. As a part of this effort, FPL has developed a new blade geometry, identified factors that cause saw instability, and found new stronger blade materials. FPL determined that a major contributor to thin blade instability is the constant expansion and contraction

Difference in thickness between old and new saw blades.

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of the blade material. During operation, the blade is heated by the cutting process and is water cooled to prevent the wood from scorching. The cyclic heating and cooling of the blade material causes the blade to become unbalanced and thus, wobble. To alleviate this thermal expansion problem, FPL identified two new low-expansion superalloys, *INCOLOY® alloys 908 and 909 as candidate blade materials. The new alloys are stronger than conventional carbon steel, so the blades can be thinner, and they have very low thermal expansion properties, which increases the blades' thermal stability. However, both alloys 908 and 909 have significantly high residual stresses due to the rolling process that is used to make the thin blade stock. These stresses cause distortion (warping) of the thin blades that cannot be corrected with conventional methods. FPL tried several methods, including heat treating, to flatten out the blades. All of them failed. Even the material developers at Inco Alloys International, Inc. could not suggest a heat treatment for alloys 908 and 909, so FPL contacted the Commercial Technology Office at Lewis for some help. The Commercial Technology Office suggested that FPL contact the researchers in the Aerospace Technology Directorate.

In response, Lewis researchers developed a new heat treatment process that not only flattened the alloy 908 alloy plates but also significantly reduced the residual stresses that caused the blades to warp. In addition, the heat treatment process increased the strength of the alloy 908 by over 12 percent with only a slight decrease in the material's ductility (from an average of 17- to 13-percent ductility).

Thin saw blade fabrication starts with thin blade stock. Traditionally, thin plate material (approximately 1/4 in.) was used. To produce thinner stock, plates are rolled into thinner sheets of material. Maintaining stock flatness requires the material to be rolled several times in different directions. This rolling process produces a residual stress state in the material. These residual stresses warp and distort the blades as they are machined out of the sheet stock. The heat treatment process developed at Lewis will minimize this distortion by reducing the level of residual stresses. In addition, this heat treatment process will increase the strength of a material by over 12 percent with only a slight decrease in ductility.

Options for Commercialization

This heat treatment process has been transferred to Inco Alloys International through a Space Act Agreement. Lewis researchers are working with Inco to develop an economic means to scale up the process to a production mode. Inco is actively seeking other uses for this material modified with the Lewis heat treatment process. The thin saw blade technology has been proven by FPL. New blades will be field tested by December 1996, and a commercial version of the blade will be available soon after the successful proof test.

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Key Words

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